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# Tuna Fishery in the East Central Atlantic Region: The Feasibility of Nigeria's Participation

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**TUNA FISHERY IN THE EAST CENTRAL ATLANTIC  
REGION : THE FEASIBILITY OF NIGERIA'S  
PARTICIPATION**

**BY**

**ADEREMI OLASUPO ABIOYE**

**A MAJOR PAPER SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE OF  
MASTER OF MARINE AFFAIRS**

**UNIVERSITY OF RHODE ISLAND**

**1987**

***Abstract***

Tuna fishery is widely practiced in the east central Atlantic region by many fleets of different nationality. Most of the catch is taken by distant-water fleets. The new Law of the Sea convention which gives coastal states an exclusive economic zone with outer limit of 200 miles, now allows the coastal states to make the most use of the living resources in their waters. The surplus shall be allocated to other states in the region and those traditionally fishing in the area before.

Nigeria with a population of about 100 million people spends substantial foreign exchange annually on the importation of fish and fish products from other countries. Due to the current tough economic condition, Nigeria is about to enter tuna fishery in the east central Atlantic ocean in order to limit the outflow of foreign exchange and to provide more protein to the population. The project looks feasible so far.

***Acknowledgements***

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## **1. Introduction**

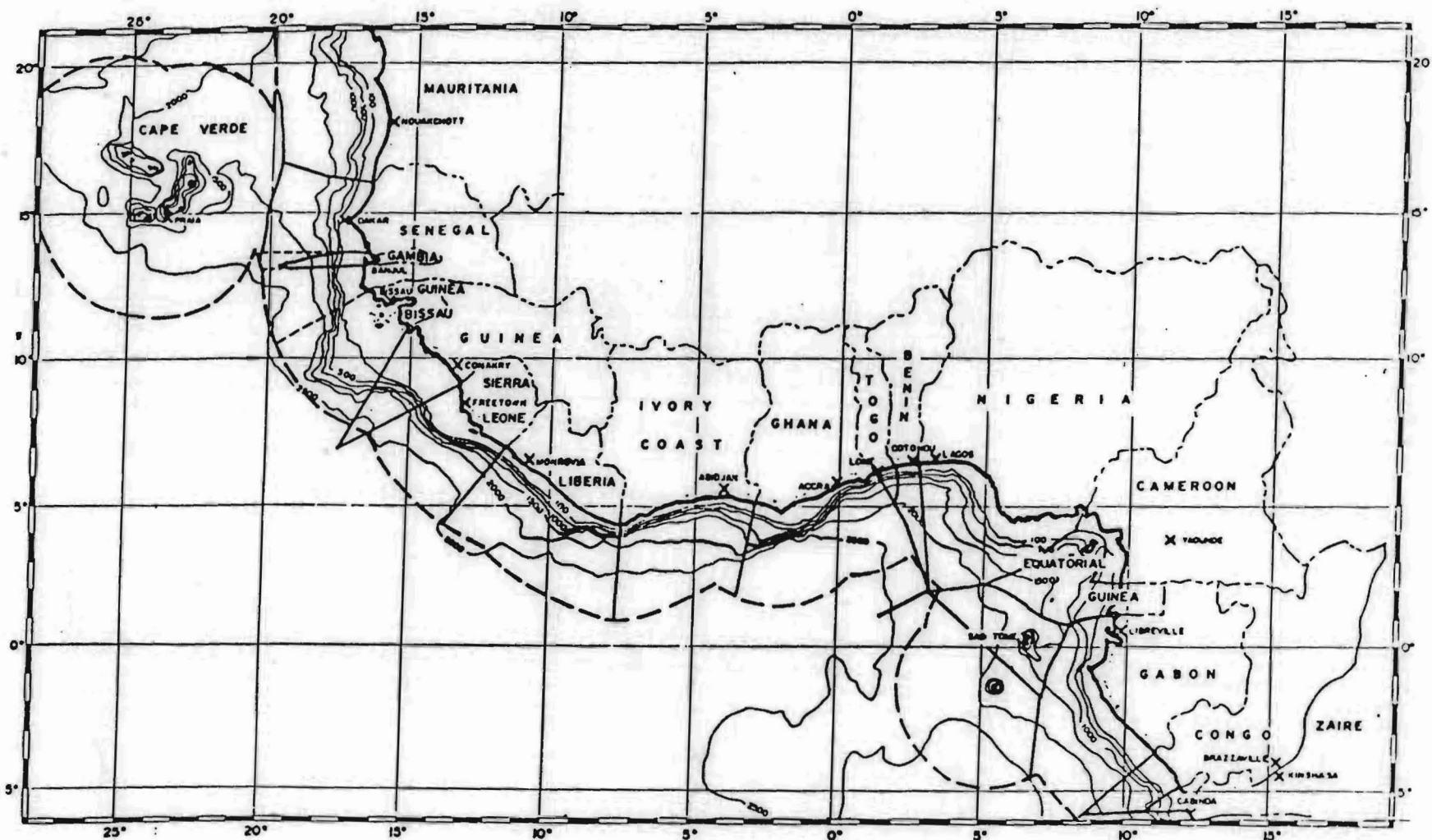
Tuna is a high value fish and is largely consumed in the markets of the United States, Japan and Western Europe. Inevitably, it has become an export commodity for those less developed countries which possess substantial resources under the Exclusive Economic Zone regime.

The Eastern Central Atlantic region extends from the Gibraltar Straits to the Congo River, which is nearly 10,000 kilometers of coastline. The coastal climate is generally characterized by the sub-tropical upwelling conditions in the north (foggy and mild atmosphere along the sea border, cool and nutrient-rich waters), desert and savannah conditions further south, and tropical conditions near the Equator. The coastal belt is mainly low-lying, and along the Gulf of Guinea, there are numerous lagoons behind a narrow sand-bar.<sup>1</sup>

There are 17 independent coastal developing countries in the region. The main islands are the Canaries, Madeira, Cape Verde, Sao Tome and Principe, and Annabon and Bioca which form part of Equatorial Guinea. The Angolan province of Cabinda is also found in the region. Apart from the population of Nigeria, nearing 95 million, Zaire with 27 million, Morocco with 19 million, and Ghana with 11 million, no country in the region has more than 10 million persons, and the region is characterized by a large number of countries with small populations. There is a considerably greater density of population in countries bordering the northern Gulf of Guinea (Ivory Coast to Cameroon). (Figure 1)

In general, the continental shelf off West Africa is less than 20 to 30 nautical miles wide except in the area between latitudes 24 to 20°N and the area between Dakar (15°N) and Freetown (8°N) where the shelf is up to about 100 miles wide. The two major currents in the region are the cool currents flowing southward down northwest Africa (the Canary Current) and northward up from southwest Africa (the Benguella Current), and both

FIGURE 1: THE 200 MILE ZONES OF WEST AFRICA (based on equidistance)



Source: Peter Underwood, 1983 (Expanded Maritime Jurisdiction: New Prospects for the West African Fisheries. Dalhousie Ocean Studies Programme).

currents gradually flow westwards at about 5°N and 10°S of the Equator respectively. Between these two currents are the Equatorial Countercurrent and its continuation, the Guinea current, which flows eastwards into the Gulf of Guinea (Figure 2). It is between the cool Canary and Benguella Currents that sea temperatures of 27°C are consistently found. There are seasonal upwellings - and this is essential for resources distribution - in some parts of the Canary Current system (roughly from 20 to 10°N), off Ivory Coast, Ghana, Togo, Benin as well as off southern Gabon, Congo and Zaire. Morocco has the most extensive coastline of all coastal countries with a length of 1400 km. Other countries have coastlines generally exceeding 300 km. in length. The countries which have the smallest coastlines are Zaire (40 km.), Togo (20 km.), The Gambia (70 km.), Benin (120 km.) and Congo (160 km.).

Tuna are common throughout the region, and the most frequently caught species are skipjack, yellowfin and bigeye. Most tuna species have wide-ranging migratory patterns which vary both seasonally and annually. They move freely both within and outside national jurisdictions (Figure 3). There may be strong incentives for individual states to maximize their immediate gains from these migratory stocks, and to do so without regard to the long-term consequences. In fact, a rapidly increasing demand for tuna has led to a rapid growth in the number and size of tuna vessels, many of which are capable of fishing anywhere in the world's oceans. Current tuna fisheries are based primarily on six species - yellowfin (*Thunnus albacares*), albacore (*T. alalunga*), bluefins (*T. thynnus* and *T. maccoyii*), bigeye (*T. obesus*), and skipjack (*Katsuwonus pelamis*). The first, and the last two are the tropical species, others are temperate tunas. These six major market species presently comprise about 75% of the world catch and nearly 100% of the international trade of tuna and tunalike species.<sup>2</sup> There are about thirty-five secondary market species of tunalike fishes including bonito (*Sarda* spp.), frigate mackerel (*Auxis* spp.), little tunas (*Euthynnus* spp.), and blackfin (*T. atlanticus* and *T. tongoll*).

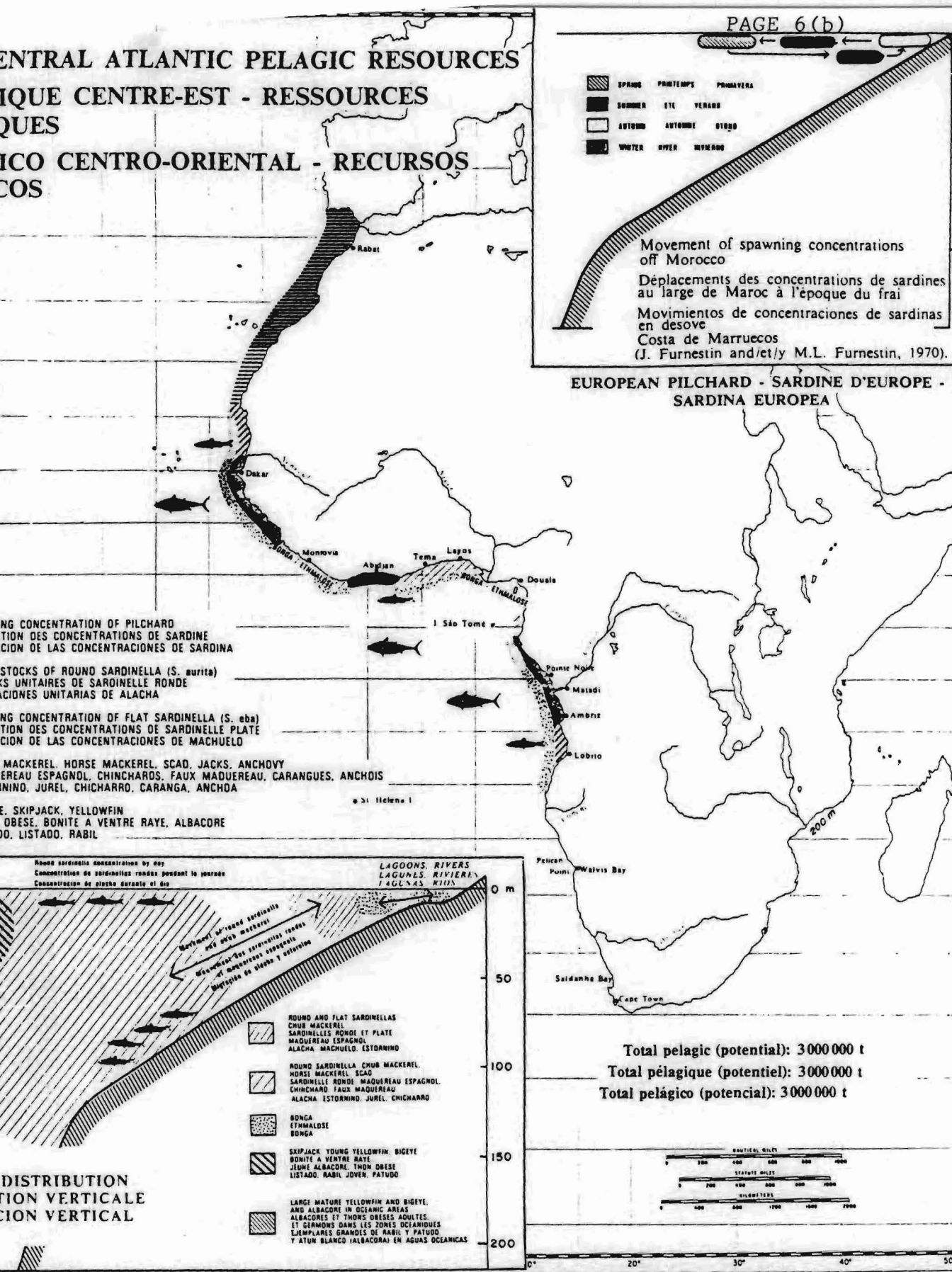


Figure 3.

Although the bigeye and the yellowfin tunas grow to a large size (up to 100 kg. or more), they are relatively short-lived, compared with temperate species. They have a total life span five years or less (Joseph, 1973). The skipjack is smaller than the other two tropical species and rarely reaches 15 kg. in weight. It too is short-lived compared with the temperate tunas. The fact that tunas are wide ranging in their migrations adds to the complexity of appropriate management schemes. Blackburn (1965) has suggested that the yellowfin and bigeye tuna have a vertical depth range from the surface to at least 150 meters. Skipjack, however, are not regarded as commonly occurring below 70 meters. These tunas seem to have the same general depth range in the high seas as well as over the continental shelves. The principal fishing methods are purse seining, long lining, and baitboat fishing.



## 2. Tuna Resources of the Region

Scombrids are dioecious (separate sexes) and most display little or no sexual dimorphism in structure or colour pattern. Females of many species attain larger sizes than males. Batch spawning of most species takes place frequently inshore. The eggs are pelagic and hatch into plankton larvae. Scombrids are active predators. Tunas feed on small fishes, crustaceans and squids.<sup>3</sup>

**Yellowfin tuna (*Thunnus albacares*)** They are epipelagic, oceanic, above and below the thermocline. Vertical distribution appears to be influenced by the thermal structure of the water column, as is shown by the close correlation between the vulnerability of the fish to purse seine capture, the depth of the mixed layer, and the strength of the temperature gradient within the thermocline.<sup>4</sup> Yellowfin tuna are essentially confined to the upper 100 meters of the water column in areas with marked oxyclines, since oxygen concentrations less than 2 ml./ litre encountered below the thermocline and strong thermocline gradients tend to exclude their presence in waters below the discontinuity layer. Larval distribution in equatorial waters is transoceanic the year round, but there are seasonal changes in larval density in subtropical waters.<sup>5</sup> It is believed that the larvae occur exclusively in the warm water sphere, that is, above the thermocline.

Schooling occurs more commonly in near-surface waters, primarily by size, either in monospecific or multispecies groups. Association with floating debris and other objects is also observed. Spawning occurs throughout the year in the core areas of distribution, but peaks are always observed in the northern and southern summer months respectively.<sup>6</sup> Maximum fork length is over 200 cm. Common to 150 cm. fork length. All fish over 120 cm. attain sexual maturity.

***Bigeye tuna (Thunnus obesus)*** Found worldwide in tropical and subtropical waters of the Atlantic, Indian and Pacific oceans, but absent from the Mediterranean.<sup>7</sup> They are epipelagic and mesopelagic in oceanic waters, occurring from the surface to about 250 m. depth. Temperature and thermocline depth seem to be the main environmental factors governing the vertical and horizontal distribution of bigeye tuna. Water temperatures in which the species has been found range from 13° to 29°C, but the optimum range lies between 17° and 22°C.<sup>8</sup> This coincides with the temperature range of the permanent thermocline. Juveniles and small adults of bigeye tuna school at the surface in monospecies groups or together with yellowfin tuna and/or skipjack. Schools may be associated with floating objects.

Mature fish spawn at least twice a year, the number of eggs per spawning has been estimated at 2.9 million to 6.3 million.<sup>9</sup> The food spectrum of bigeye tuna covers a variety of fish species, cephalopods and crustaceans, thus not diverging significantly from that of other similar-sized tunas. Feeding occurs in daytime as well as at night. The main predators are large billfish and toothed whales.<sup>10</sup> Maximum fork length is over 200 cm.; common to 180 cm. (corresponding to an age of at least three years). Maturity is attained at 100 to 130 cm. fork length.

***Skipjack tuna (Katsuwonus pelamis)*** An epipelagic, oceanic species with adults distributed roughly within the 15°C isotherm (overall temperature range of occurrence is 14.7° to 30°C), while larvae are mostly restricted to waters with surface temperatures of at least 25°C. Aggregations of this species tend to be associated with convergences, boundaries between cold and warm water masses (i.e., the polar front), upwelling and other hydrographical discontinuities.<sup>11</sup> Depth distribution ranges from the surface to about 260 m. during the day, but is limited to near surface waters at night. Skipjack tuna spawn in batches throughout the year in equatorial waters. Fecundity increases with size but is highly variable, the number of eggs per season in females of 41 to 87 cm. fork length



ranging between 80,000 and 2 million.<sup>12</sup>

Food items include fishes, crustaceans and molluscs. The feeding activity peaks in the early morning and in the late afternoon. Cannibalism is common. The principal predators of skipjack are other tunas and billfishes. Studies of the local movements of skipjack tuna showed that small fish (less than 45 cm. fork length) made nightly journeys of 25 to 106 km. away from a bank but returned in the morning, while big individuals moved around more independently.<sup>13</sup> Skipjack tuna exhibit a strong tendency to school in surface waters. Schools are associated with birds, drifting objects, sharks, whales and other tuna species and may show a characteristic behavior (jumping, feeding, foaming, e.t.c.). Estimates of longevity vary at least between 8 and 12 years. Maximum fork length is about 108 cm. corresponding to a weight of 32.5 to 34.5 kg.; common to 80 cm. fork length and a weight of 8 to 10 kg. Fork length at first maturity is about 45 cm. Skipjack made up about 40% of the world's total tuna catch and have come to replace yellowfin as the dominant tuna species over the past few years.<sup>14</sup> Skipjack tuna is taken at the surface, mostly with purse seines and pole-and-line gear but also incidentally by longlines. Skipjack tuna are marketed fresh, frozen or canned.

***Northern bluefin tuna (Thunnus thynnus)*** This species is found around the Canary Islands and off Morocco's coast. They are epipelagic, usually oceanic but seasonally coming close to shore. They tolerate a wide range of temperatures. Up to a size of 40 to 80 kg., they school by size, sometimes together with albacore, yellowfin, bigeye, skipjack, frigate tuna e.t.c. Onset of maturity is at about 4 or 5 years. Females weighing between 270 to 300 kg. may produce as many as 10 million eggs per spawning season. Variations in the food spectrum are attributed primarily to behavioural differences in feeding. 'Vigorous pursuit' would be required to prey on small schooling fishes (anchovies, sauries, hakes) or on squids, while 'modified filter-feeding' is used to feed on red crabs and other less agile organisms. In turn, northern bluefin tuna are preyed upon by killer whales (*Orcinus orca*),

pilot whales and blackfish. However, the rather large size of adults drastically reduces the number of potential predator species. The maximum fork length is over 300 cm.; common to 200 cm. In the warm waters off the Canary Islands, the biggest fish in commercial catches range between 350 and 400 kg.<sup>15</sup>

**Albacore (*Thunnus alalunga*)** Cosmopolitan in tropical and temperate waters of all oceans including the Mediterranean Sea, extending north to 45° - 50°N and south to 30° - 40°S, but not at the surface between 10°N and 10°S. It is an epi- and meso-pelagic oceanic species. In the Atlantic, the larger size classes (80 to 125 cm.) are associated with cooler water bodies, while smaller individuals tend to occur in warmer strata. Albacore migrate within water masses rather than across temperature and oxygen boundaries. Throughout its range, the albacore migrate over great distances and appears to form separate groups at different stages of its life cycle. The depth distribution in the Atlantic ranges from the surface down to around 600 m. Like other tunas, albacore form schools with fewer fish, hence more compact units when composed of larger fish. They may also form mixed schools with skipjack tuna, yellowfin tuna and bluefin tuna. Schools may be associated with floating objects, including sargassum weeds.

A 20 kg. female may produce between 2 and 3 million eggs per season, which are released at least in two batches. The sex ratios in catches is about 1:1 for immature specimens, but males predominate among mature fishes, which is possibly due to both differential mortality of sexes, and differential growth rate after maturity. Maximum fork length is 127 cm. Males up to 109 cm. and females up to 106 cm. are not exceptional in the Atlantic. Maturity is attained at about 94 cm. in both sexes.

**Bullet tuna (*Auxis spp.*)** This genus is epipelagic, neritic and oceanic in warm waters with strong schooling behaviour. Though larvae have a high temperature tolerance (at least between 21.6° and 30.5°C), the widest among tuna species studied, their optimum temperature is between 27° and 27.9°C, and the species is usually confined to

oceanic salinities. Spawning is believed to occur in several batches of up to 1 million eggs.<sup>16</sup> Food is primarily selected by the size of the gillrakers and consist of fishes, crustaceans, cephalopods and others. In turn, *Auxis* spp. are preyed upon primarily by large tunas, billfishes, barracudas, various sharks and others. *Auxis* are appreciated food fish, but the quality of the meat deteriorates rather rapidly after death. They are canned, flake-dried and smoked. The maximum fork length is 50 cm. in Japanese catches, 35 cm. is the average.

***Little tunny (Euthynnus alletteratus)*** Epipelagic, neritic species, typically occurring in inshore waters. Spawning extends from about April to November in the East Atlantic.<sup>17</sup> Eggs are shed in several batches when the water is warmest. In the juvenile stages, the sex ratio is approximately 1:1, whereas in mature phase males predominate in the catches. Little tunny is an opportunistic predator feeding on virtually everything within its range, i.e. crustaceans, fishes, squids, heteropods and tunicates. It is in turn preyed upon, among others, by sharks, large yellowfin tuna and billfishes.

Growth estimates suggest that little tunny grow to almost 30 cm. length in their first year. Maturity is reached at a length of about 40 cm. off Senegal, and 45 cm. in the Gulf of Guinea. Size of little tunny in commercial catches ranges roughly from 30 to 80 cm. fork length. The largest reported landing of this species were made by Ghana (54 to 6,049 metric tons, stabilizing between 5,000 and 6,000 metric tons in recent years) Ivory coast (38 to 860 tons, but recently reporting low catches between 50 and 200 tons), and Mauritania (estimated by FAO at about 1,000 metric tons). The present catch could probably be increased if the species were in higher demand.<sup>18</sup>

***Plain bonito (Orcynopsis unicolor)*** Generally found in the northern part of the east central Atlantic. It is an epipelagic, neritic species confined primarily to temperate waters, but juveniles may be encountered in waters of up to 30°C. Small schools of plain bonito cruise at the surface (so that the first dorsal fin stands out of the water like sharks). Plain

bonito prey on a variety of mostly small schooling fishes including anchovies, sardinellas, jacks, mackerel and others. Spawning season extends from May to September off Senegal. A female weighing 5 or 6 kg. may carry some 500 to 600,000 eggs which are spawned in portions. Maximum size is 130 cm fork length and 13.1 kg. weight; common to 90 cm. and 4 to 5 kg. Females grow larger than males. Maturity is reached at about 70 to 80 cm fork length. There seems to be no fishery directed at this species. It is taken incidentally in Morocco, Mauritania, and Senegal. The major fishing gear is pole-and-line, but it is also caught with purse seines. Plain bonito is marketed canned or frozen.<sup>19</sup>

**Atlantic bonito (*Sarda sarda*)** Found along the coast of the East Central Atlantic Region. It is an epipelagic, neritic, schooling species that can adapt to gradual but not sudden changes in the environment and may occur in water temperatures between 12° and 27°C and salinities between 14 and 39‰S. In the eastern Atlantic, spawning occurs from December to June, including peaks in January and April, off Dakar, and from June to July in Moroccan waters.<sup>20</sup> Maximum fork length is 78 cm. and 7.6 kg. weight (off Canary Island). Common to 50 cm. fork length and about 2 kg. weight. Minimum length at first maturity is about 39.5 cm. in males and 40.5 cm. in females.

**West African Spanish Mackerel (*Scomberomorus tritor*)** This species is found in Eastern Atlantic, concentrated in the Gulf of Guinea from the Canary Islands and Dakar south to Baia dos Tigres, southern Angola. It is an epipelagic, neritic species penetrating into coastal lagoons. The spawning season is believed to extend from April to October in Senegal.<sup>21</sup> Approximately 1 million eggs were estimated in a 95 cm. long female (Postel 1955). In Lagos lagoon the species feeds on clupeids particularly *Ethmalosa frimbiata* (Fagade and Olaniyan, 1973). Maximum fork length is at least 98 cm. in females, and 84 cm. in males; commonly ranging between 50 and 70 cm. Fork length at first maturity is 45 cm. for both sexes (Postel, 1955).



### ***3. Tuna Fishery in the Region***

#### ***(i) Fishing methods***

The major share of all tuna taken in the world is captured using one of three methods. The first is longline, which consists of long strings of hooks suspended from a main line. The hooks extend vertically in the water column reaching depths of nearly one hundred fathoms. A single vessel generally handles approximately two thousand hooks which hang from a main line that may be as long as seventy-five miles. This form of fishing is used primarily by the Japanese and exclusively by the Taiwanese and Koreans. Longlining is generally considered to be relatively selective in fish size because this fishery tends to concentrate on larger fish (Joseph, 1972).

The second most important fishing technique used to capture tuna is live-bait fishing. This technique involves chumming the tuna near the vessel with live-bait. When the tuna are feeding frantically, they are jerked from the water with poles to which artificial lures are attached. This fishery is generally carried out closer to shore than longline fishery because of the problem of maintaining the live bait. This type of fishery is also considered to be extremely difficult and arduous work.

The third most important fishing technique, in terms of total quantity landed, is purse-seining. This technique relies on the capture of the surface schools of tuna with very large encircling nets. It is by far the most productive method of tuna fishing in terms of yield per day on the fishing grounds and is fast supplanting bait fishing as the most important surface fishing technique.<sup>22</sup> The net is drawn shut at the bottom to prevent the tunas from escaping, pulled to the boat, and the tunas taken on board. This technique is quite capital intensive compared with the relatively labour intensive longline and especially the live bait method. The purse seine fishery does have certain constraints in that the most effective fishing takes place where the thermocline is relatively shallow. This is necessary

to prevent large quantities of tuna from escaping as the net is set and the bottom drawn shut. Of the three techniques mentioned here, the purse seine is the least selective with respect to fish size (Saila et al, 1974).

Tuna aggregations are formed in the upwelling zones and in the areas of adjacent waters of different origins. These two zones are characterized by the highest productivity, are rich in nutrients, plankton, fish and cephalopod aggregations. These conditions are typical of the Guinean Hollow in the western part of the Gulf of Guinea which is an important area in the longline fishery.<sup>23</sup>

***(ii) Total Catch by Species (see Table 1)***

Yellowfin tuna (*Thunnus albacares*) -- according to the FAO yearbook of fishery statistics (catches and landings) for 1983, the total catch of this species in the east central Atlantic ocean was 109,467 metric tons in 1980, 123,841 metric tons in 1981, 112,889 metric tons in 1982, and 111,176 metric tons in 1983.

Bigeye tuna (*Thunnus obesus*) -- the total catch of this species in the east central Atlantic ocean in 1980 was 30,843 metric tons, 23,294 metric tons in 1981, 28,190 metric tons in 1982, and 28,936 metric tons in 1983 (FAO 1983 yearbook of fishery statistics, Vol. 56).

Albacore (*Thunnus alalunga*) -- the total catch of this species in the east central Atlantic ocean was 2,924 metric tons in 1980, 3,312 metric tons in 1981, 3,109 metric tons in 1982, and 2,670 metric tons in 1983. (FAO 1983 yearbook of fishery statistics, Vol. 56).

Skipjack tuna (*Katsuwonus pelamis*) -- the total catch of this species in the east central Atlantic ocean was 88,859 metric tons in 1980, 105,750 metric tons in 1981, 116,672

metric tons in 1982, and 111,937 metric tons in 1983. (FAO 1983 yearbook of fishery statistics, Vol. 56).

Northern bluefin tuna (*Thunnus thynnus*) -- the total catch of this species in the east central Atlantic ocean was 1,260 metric tons in 1980, 1,297 metric tons in 1981, 2,117 metric tons in 1982, and 1,598 metric tons in 1983. (FAO 1983 yearbook of fishery statistics, Vol. 56).

Bullet and frigate tunas (*Auxis* spp.) -- the total catch of these species in the east central Atlantic ocean was 8,748 metric tons in 1980, 3,372 metric tons in 1981, 6,601 metric tons in 1982, 7,149 metric tons in 1983. (FAO 1983 yearbook of fishery statistics, Vol. 56).

Little tuna (*Euthynnus alletteratus*) -- the total catch of this species in the east central Atlantic ocean was 4,776 metric tons in 1980, 3,342 metric tons in 1981, 5,710 metric tons in 1982, and 6,608 metric tons in 1983. (FAO 1983 yearbook of fishery statistics, Vol. 56).

Plain bonito (*Orcynopsis unicolor*) -- the total catch of this species in the east central Atlantic ocean was 697 metric tons in 1980, 1,446 metric tons in 1981, 760 metric tons in 1982, and 383 metric tons in 1983 (FAO 1983 yearbook of fishery statistics, Vol. 56).

Atlantic bonito (*Sarda sarda*) -- the total catch of this species in the east central Atlantic ocean was 7,641 metric tons in 1980, 6,185 metric tons in 1981, 7,850 metric tons in 1982, and 3,848 metric tons in 1983 (FAO 1983 yearbook of fishery statistics, Vol. 56).

West African Spanish mackerel (*Scomberomorus tritor*) -- the total catch of this species in the east central Atlantic ocean was 4,412 metric tons in 1980, 1,983 metric tons in 1981, 3,833 metric tons in 1982, and 3,308 metric tons in 1983 (FAO 1983 yearbook of

fishery statistics, Vol. 56).

***(iii) Total Catch by Countries (see Table 2)***

There are two sets of countries fishing tuna in the east central Atlantic ocean: coastal states, and distant-water states. The coastal states include Benin, Cape Verde, Ghana, Ivory Coast, Mauritania, Morocco, Sao Tome & Principe, Senegal and Togo. The distant-water states are Bulgaria, Cuba, France, German Democratic Republic, Japan, Republic of Korea, Panama, Poland, Portugal, Romania, Spain, U.S.A. and U.S.S.R.

***Coastal States (in alphabetical order)***

Benin -- In 1981, Benin caught a total of 40 metric tons of little tunny, 40 metric tons of bigeye tuna, 64 metric tons of frigate and bullet tuna, 60 metric tons of skipjack tuna, 32 metric tons of atlantic bonito, and 100 metric tons on yellowfin tuna. In 1982, a total of 45 metric tons of little tunny was caught, 45 metric tons of bigeye tuna, 72 metric tons of frigate and bullet tuna, 68 metric tons of skipjack tuna, 36 metric tons of atlantic bonito, and 113 metric tons of yellowfin tuna. In 1983, Benin caught 52 metric tons of little tunny, 52 metric tons of bigeye tuna, 83 metric tons of frigate and bullet tuna, 78 metric tons of skipjack tuna, 41 metric tons of atlantic bonito, and 130 metric tons of yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Cape Verde -- In 1980, the total catch was 27 metric tons for bigeye tuna, 769 metric tons for yellowfin tuna, and 1,831 metric tons for skipjack tuna. In 1981, the total catch was 270 metric tons for bigeye tuna, 14 metric tons for little tunny, 3,698 metric tons for yellowfin tuna and 1,419 metric tons for skipjack tuna. In 1982, the total catch was 8 metric tons for little tunny, 110 metric tons for bigeye tuna, 1,410 metric tons for skipjack tuna, and 3,018 metric tons for yellowfin tuna. In 1983, the total catch was 174 metric tons for bigeye tuna, 1,240 metric tons for little tunny, 1,392 metric tons for skipjack



tuna, and 4,356 metric tons for yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Ghana -- the total catch in 1980 was 76 metric tons for bigeye tuna, 8,039 metric tons for frigate and bullet tunas, 4,412 metric tons for west african spanish mackerel, 4,233 metric tons for little tunny, 5,615 metric tons for skipjack tuna, 77 metric tons for atlantic bonito, and 803 metric tons for yellowfin tuna. In 1981, there was a total catch of 122 metric tons for bigeye tuna, 2,048 metric tons for frigate and bullet tunas, 1,983 metric tons for west african spanish mackerel, 2,900 metric tons for little tunny, 8,330 metric tons for skipjack tuna, 5 metric tons for atlantic bonito, and 2,976 metric tons for yellowfin tuna. In 1982, Ghanian boats caught a total of 570 metric tons of bigeye tuna, 6,062 metric tons of frigate and bullet tunas, 2,982 metric tons of west african spanish mackerel, 4,669 metric tons of little tunny, 18,044 metric tons of skipjack tuna, 71 metric tons of atlantic bonito, and 4,387 metric tons of yellowfin tuna. In 1983, a total catch of 285 metric tons of bigeye tuna was landed, 5,632 metric tons of frigate and bullet tunas, 2,771 metric tons of west african spanish mackerel, 4,338 metric tons of little tunny, 66 metric tons of atlantic bonito, 22,404 metric tons of skipjack tuna, and 2,231 metric tons of yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Ivory Coast -- In 1980, a total of 5774 metric tons of skipjack tuna was caught, also, 177 metric tons of little tunny, 231 metric tons of bigeye tuna, 77 metric tons of albacore, and 9847 metric tons of yellowfin tuna. In 1981, the total catch was 5975 metric tons of skipjack tuna, 182 metric tons of little tunny, 78 metric tons of albacore, 240 metric tons of bigeye tuna, and 10,193 metric tons of yellowfin tuna. In 1982, there was a total catch of 329 metric tons of bigeye tuna, 150 metric tons of frigate and bullet tunas, 150 metric tons of little tunny, 8,310 metric tons of skipjack tuna, 128 metric tons of albacore, and 8,829 metric tons of yellowfin tuna. In 1983, there was a total catch of 8,099 metric tons of skipjack tuna, 146 metric tons of little tunny, 321 metric tons of bigeye tuna, 146

metric tons of frigate and bullet tunas, 125 metric ton of albacore, and 8,604 metric tons of yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Mauritania --- In 1980, a total catch of 31 metric tons of little tunny was landed, and also 101 metric tons of plain bonito. In 1981, there was a total catch of 86 metric tons of little tunny, and 478 metric tons of plain bonito. In 1982, there was a total catch of 76 metric tons of little tunny, and 99 metric tons of plain bonito. In 1983, there was a total catch of 54 metric tons of little tunny, and 37 metric tons of plain bonito. (FAO 1983 yearbook of fishery statistics, Vol. 56)

Morocco --- In 1980, there was a total catch of 16 metric tons of little tunny, 596 metric tons of plain bonito, 706 metric tons of frigate and bullet tunas, 259 metric tons of atlantic bonito, 155 metric tons of northern bluefin tuna, and 2,897 metric tons of skipjack tuna. In 1981, the total catch was 1,257 metric tons of frigate and bullet tunas, 19 metric tons of little tunny, 968 metric tons of plain bonito, 477 metric tons of atlantic bonito, 105 metric tons of northern bluefin tuna, and 156 metric tons of skipjack tuna. In 1982, the total catch was 29 metric tons for little tunny, 661 metric tons of plain bonito, 211 metric tons of frigate and bullet tunas, 644 metric tons of atlantic bonito, 508 metric tons of northern bluefin tuna, and 598 metric tons of skipjack tuna. In 1983, the total catch was 19 metric tons of little tunny, 346 metric tons of plain bonito, 1,226 metric tons of frigate and bullet tunas, 552 metric tons of atlantic bonito, 275 metric tons of northern bluefin tuna and 208 metric tons of skipjack tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Sao Tome & Principe --- In 1980, there was a total catch of 33 metric tons of atlantic bonito, and 31 metric tons of yellowfin tuna. In 1981, there was a total catch of 90 metric tons of atlantic bonito, and 97 metric tons of yellowfin tuna. In 1982, there was a total catch of 78 metric tons and 193 metric tons of atlantic bonito and yellowfin tuna respectively. In 1983, there was a total catch of 103 metric tons of atlantic bonito, and

149 metric tons of yellowfin tuna (FAO yearbook of fishery statistics, Vol. 56).

Senegal --- In 1980, the total catch was 67 metric tons of skipjack tuna, and 69 metric tons of yellowfin tuna. In 1981, the total catch was 8 metric tons of bigeye tuna, 1,772 metric tons of skipjack tuna, and 543 metric tons of yellowfin tuna. In 1982, there was a total catch of 40 metric tons of bigeye tuna, 1,446 metric tons of skipjack tuna, and 887 metric tons of yellowfin tuna. In 1983, the total catch was 40 metric tons of bigeye tuna, 1,446 metric tons of skipjack tuna, and 887 metric tons of yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Togo --- In 1983, there was a total catch of 14 metric tons of bigeye tuna. There was no landing in 1980, 1981, and 1982 because tuna fishing started in 1983 (FAO 1983 yearbook of fishery statistics, Vol. 56).

***Distant-water fleets (in alphabetical order)***

Bulgaria --- In 1980, there was a total catch of 3 metric tons of frigate and bullet tunas, and 75 metric tons of atlantic bonito. In 1981, there was a total catch of 3 metric tons of frigate and bullet tunas, and 8 metric tons of atlantic bonito. In 1982, the total catch was 23 metric tons of atlantic bonito. In 1983, there was a total catch of 7 metric tons of frigate and bullet tunas, 46 metric tons of atlantic bonito, and 7 metric tons of skipjack tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Cuba --- In 1980, there was a total catch of 1,385 metric tons of bigeye tuna, 131 metric tons of little tunny, 56 metric tons of albacore, 171 metric tons of skipjack tuna, and 5,817 metric tons of yellowfin tuna. In 1981, there was a total catch of 711 metric tons of bigeye tuna, 53 metric tons of little tunny, 184 metric tons of skipjack tuna, 101 metric tons of albacore, and 4,942 metric tons of yellowfin tuna. In 1982, the total catch was 520 metric tons of bigeye tuna, 45 metric tons of little tunny, 90 metric tons of albacore, 189 metric tons of skipjack tuna, 3,689 metric tons of yellowfin tuna, and 6

metric tons of northern bluefin tuna. In 1983, there was a total catch of 418 metric tons of bigeye tuna, 135 metric tons of skipjack tuna, 56 metric tons of albacore, and 2,438 metric tons of yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

France --- In 1980, there was a total catch of 3,185 metric tons of bigeye tuna, 21,409 metric tons of skipjack tuna, and 39,828 metric tons of yellowfin tuna. In 1981, the total catch was 424 metric tons of bigeye tuna, 27,243 metric tons of skipjack tuna, and 39,547 metric tons of yellowfin tuna. In 1982, the total catch was 1,901 metric tons of bigeye tuna, 25,062 metric tons of skipjack tuna and 32,010 metric tons of yellowfin tuna. In 1983, there was a total catch of 2,583 metric tons of bigeye tuna, 29,611 metric tons of skipjack tuna, and 24,763 metric tons of yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56)

German Democratic Republic --- In 1980, there was a total catch of 288 metric tons of atlantic bonito. In 1981, there was a total catch of 440 metric tons of atlantic bonito. In 1982, there was a total catch of 106 metric tons of frigate and bullet tunas, 851 metric tons of west african spanish mackerel, 397 metric tons of little tunny, and 146 metric tons of atlantic bonito. In 1983, there was a total catch of 55 metric tons of frigate and bullet tunas, 537 metric tons of west african spanish mackerel, 543 metric tons of little tunny, and 274 metric tons of atlantic bonito. (FAO 1983 yearbook of fishery statistics, Vol. 56)

Japan --- In 1980, there was a total catch of 8,864 metric tons of bigeye tuna, 10,448 metric tons of skipjack tuna, 2,265 metric tons of yellowfin tuna, 752 metric tons of northern bluefin tuna, and 76 metric tons of albacore. In 1981, the total catch was 6,162 metric tons of bigeye tuna, 15,227 metric tons of skipjack tuna, 1,473 metric tons of yellowfin tuna, 229 metric tons of northern bluefin tuna, and 100 metric tons of albacore. In 1982, there was a total catch of 12,479 metric tons of bigeye tuna, 11,041 metric tons of skipjack tuna, 4,012 metric tons of yellowfin tuna, 165 metric tons of northern bluefin tuna, and 86 metric tons of albacore. The total catch in 1983 was 12,902 metric tons of



bigeye tuna, 11,416 metric tons of skipjack tuna, 4,148 metric tons of yellowfin tuna, 171 metric tons of northern bluefin tuna, and 89 metric tons of albacore (FAO 1983 yearbook of fishery statistics, Vol. 56).

Korea (Republic) --- In 1980, there was a total catch of 9,099 metric tons of bigeye tuna, 6,154 metric tons of skipjack tuna, 1,208 metric tons of albacore, and 7,523 metric tons of yellowfin tuna. In 1981, the total catch was 10,265 metric tons of bigeye tuna, 1,140 metric tons of albacore, 4,981 metric tons of skipjack tuna, and 7,007 metric tons of yellowfin tuna. In 1982, there was a total catch of 8,989 metric tons of bigeye tuna, 3,407 metric tons of skipjack tuna, 1,131 metric tons of albacore, and 5,171 metric tons of yellowfin tuna. The total catch in 1983 was, 6,863 metric tons of bigeye tuna, 2,227 metric tons of skipjack tuna, 561 metric tons of albacore, 3 metric tons of northern bluefin tuna, and 2,658 metric tons of yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Panama --- In 1980, there was a total catch of 3,245 metric tons of bigeye tuna, 58 metric tons of little tunny, 1,735 metric tons of skipjack tuna, 1,645 metric tons of yellowfin tuna, and 117 metric tons of northern bluefin tuna. In 1981, the total catch was 144 metric tons of skipjack tuna, 2,002 metric tons of bigeye tuna, 36 metric tons of little tunny, 48 metric tons of northern bluefin tuna, and 263 metric tons of yellowfin tuna. In 1982, there was a total catch of 2,541 metric tons of skipjack tuna, 12 metric tons of northern bluefin tuna, and 1,610 metric tons of yellowfin tuna. The total catch in 1983 was 2,636 metric tons of bigeye tuna, 1,611 metric tons of skipjack tuna, and 1,682 metric tons of yellowfin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Portugal --- In 1980, there was a total catch of 224 metric tons of bigeye tuna, 121 metric tons of little tunny, 13 metric tons of atlantic bonito, 465 metric tons of skipjack tuna, 7 metric tons of northern bluefin tuna, 7 metric tons of albacore, and 577 metric tons of yellowfin tuna. In 1981, the total catch was 130 metric tons of skipjack tuna, 9 metric

tons of yellowfin tuna, and 391 metric tons of northern bluefin tuna. In 1982, there was a total catch of 90 metric tons skipjack tuna, 16 metric tons of yellowfin tuna, and 861 metric tons of northern bluefin tuna. There was, in 1983, a total catch of 28 metric tons of skipjack tuna, 6 metric tons of yellowfin tuna, and 714 metric tons of northern bluefin tuna (FAO 1983 yearbook of fishery statistics, Vol. 56).

Romania - In 1980, there was a total catch of 9 metric tons of little tunny, and 64 metric tons of atlantic bonito. In 1981, there was a total catch of 12 metric tons of little tunny, and 81 metric tons of atlantic bonito. In 1982, the total catch was 291 metric tons of little tunny, and 249 metric tons of atlantic bonito. In 1983, there was a total catch of 216 metric tons of little tunny, and 192 metric tons of atlantic bonito (FAO 1983 yearbook of fishery statistics - vol. 56).

Spain - In 1980, the total catch was 3500 metric tons of bigeye tuna, 469 metric tons of atlantic bonito, 30,527 metric tons of skipjack tuna, 38,683 metric tons of yellowfin tuna, 500 metric tons of albacore, and 200 metric tons of northern bluefin tuna. In 1981, there was a total catch of 2,313 metric tons of bigeye tuna, 500 metric tons of atlantic bonito, 37,917 metric tons of skipjack tuna, 1,009 metric tons of albacore, 50,866 metric tons of yellowfin tuna, and 524 metric tons of northern bluefin tuna. In 1982, there was a total of 2493 metric tons of bigeye tuna, 539 metric tons of atlantic bonito, 44,466 metric tons of skipjack tuna, 48,636 metric tons of yellowfin tuna, 625 metric tons of albacore, and 565 metric tons of northern bluefin tuna. In 1983, the total catch was 1,919 metric tons of bigeye tuna, 415 metric tons of atlantic bonito, 33,256 metric tons of skipjack tuna, 768 metric tons of albacore, 58,799 metric tons of yellowfin tuna, and 435 metric tons of northern bluefin tuna (FAO 1983 yearbook of fishery statistics - vol. 56).

United States of America - The total catch in 1980 was 1,766 metric tons of skipjack tuna, and 884 metric tons of yellowfin tuna. In 1981, there was a total catch of 2,212 metric tons of skipjack tuna, and 1684 metric tons of yellowfin tuna. In 1982 there was

no catch, while in 1983, there was only a total catch of 19 metric tons, all skipjack tuna (FAO 1983 yearbook of fishery statistics - vol.56).

Union of Soviet Socialist Republic - The main species caught by the Soviet fleet is atlantic bonito. In 1980, there was a total catch of 6,306 metric tons, 4521 metric tons in 1981, 6,058 metric tons in 1982 and 2,153 metric tons in 1983 (FAO 1983 yearbook of fishery statistics - Vol. 56).

#### **4. State of Stocks**

Yellowfin tuna - In the east Atlantic, where most yellowfin are caught, catches were stable at 130,000 and 131,000 metric tons in 1981 and 1982 respectively. On the other hand in 1983, there was a considerable decrease (to 108,000 metric tons) despite constant fishing effort. In 1984, the fisheries were totally changed by the departure of the FISM purse seine fleet and part of the Spanish fleet (to Indian Ocean). The East Atlantic Ocean production for 1984 has greatly declined and is provisionally estimated at 60,000 metric tons. There is a decreasing catch - per - effort trend since 1978. However, the decreased yield is mainly for large yellowfin, traditionally caught during certain periods of the year by the purse seiners. The yield of small fish seems stable. The stock seemed to be highly exploited near the maximum sustainable yield level until 1983. But the current disorder of the surface fisheries make this conclusion out of date and the stock is developing towards a much less intensive level of exploitation in 1984.<sup>24</sup>

Bigeye tuna - Catches by surface fleets have been rather stable since the mid - 1970's around 20,000 metric tons per year. The baitboat fisheries in waters off Madeira, Azores, and the Canary Islands are seasonally directed towards bigeye tuna, the combined catch of which peaked in 1974 at 14,000 metric tons. Since then it decreased gradually to 3,600 metric tons in 1982, but recovered to 6,600 metric tons in 1983. The estimated catch of bigeye tuna caught incidentally mixed with skipjack and yellowfin tunas by the baitboat fleet in the Gulf of Guinea has been less than 3,000 metric tons and the 1982 catch amounted to 1,400 metric tons, followed by a decrease to 300 metric tons in the following year. The tropical purse seine fleets harvested bigeye tuna in the range of 3,000 - 14,000 metric tons with a gradual increasing trend. Since 1961 when the longline fishery expanded substantially over the range of the bigeye distribution, the catch - per - effort in the total Atlantic has been decreasing gradually, and has been rather stable with a slight declining trend in recent years at about 60 - 65% of the level of the initial exploitation.



The stock is close to or at the maximum sustainable yield level. A reduction in fishing mortality on the young fish fishery and a simultaneous increase in fishing mortality on the large fish fishery, could result in a notable increase in yield per recruit.<sup>25</sup>

Skipjack tuna - Total Atlantic catches over the 1969 through 1983 period are marked by high year to year variability. Since 1969 the genral trend in Atlantic skipjack catches has been upward from 30,000 metric tons in 1969 to 154,000 in 1982 with several erratic fluctuations in between. Carrying capacity is a general measure of effort in the eastern Atlantic tropical tuna fishery - this can change from year to year depending on economic conditions. In 1984 a great deal of purse seine effort (capacity) was shifted to the Indian Ocean and total capacity declined approximately 25%.<sup>26</sup> Effective effort in the FISM<sup>27</sup> and Spanish fleets has increased steadily since 1969. From 1969 through the mid - 1970's, the CPUE<sup>28</sup> generally increased but variability was high. Since the mid-1970's the CPUE trend has been neither up nor down. However, the variability remains. In 1983, CPUE was down somewhat for all three vessel classes.

Small tunas - The small tunas are a complex group including more than a dozen species occupying widely varying ecological niches. Some are extremely coastal in their distribution, while others are oceanic. The fisheries are as varied as the species. A substantial part of the catches is taken by artisanal fisheries. The small tunas are also taken in industrial fisheries, both as target species and as by-catches. Many by-catches are discarded at sea because of their low value in the market. In some areas they are important targets of sport or recreational fisheries. Reported catches of small tunas, dominated by the Atlantic bonito, King and Spanish mackerels, little tunny, and frigate tunas, made almost exclusively by surface fisheries, have tended to increase with time. In recent years they have been on the order of 100,000 to 120,000 metric tons per year, about a quarter of the total Atlantic catch of tunas and tuna-like fishes. Some of the increase has obviously been due to improved reporting. Landings in Ivory Coast of by-

catches by industrial purse seine fleets of small tunas can be as high as 4,000 metric tons per year. Industrial fleet landings in Senegal are probably a bit less, but artisanal fisheries for little tuna are presently over 4,000 metric tons per year.<sup>29</sup>

### ***5. Conservation and Management measures***

The tuna and tuna-like fishes, including their close relations the billfishes, have evolved to form the suborder Scombroidei, a group of uniquely adapted species whose migratory mode of existence sets them apart from most other fishes. They are nearly all characterized by rapid growth and most species attain a large size. They spawn large numbers of eggs over vast areas of the ocean. The eggs drift after fertilization in the upper strata of the ocean where they are subject to the vagaries of ocean currents and are preyed upon by a multitude of animals. The eggs hatch quickly and the small fish grow rapidly, maintaining the populations of these species at high levels of abundance. It is this rapid growth that results in large biomasses of fish that support important fisheries worldwide. Because of their high fecundity, rapid growth, and worldwide distribution, it would be virtually impossible to overfish the tunas to a point that would threaten biological extinction. However it is possible to fish them to such a low population level that production is reduced substantially, resulting in economic chaos in world fisheries for tuna.

The migrations of tunas and billfishes carry them through the national zones of jurisdiction of many countries during their lifetime, as well as to high seas waters beyond the jurisdiction of any single nation. What happens to them on the high seas, or in any nation's zone, affects what will become of them in other areas. It is this characteristic that sets tunas and bill fish apart for other fishes, such as snappers, herrings, anchovies, and flatfishes, and which requires that they be given special treatment to insure their proper conservation and management.

During the post-World War II years to 1970 more than 90% of the catch was taken in what was termed international waters. The tunas that inhabited these international waters were considered to belong to whomever first rendered them to his own use. No one owned them, nor did any state have jurisdiction over them while they were beyond the 3 to

12 nautical mile coastal zone of national jurisdiction. It was under this international "regime" that the great tuna fishing nations developed their far-ranging fisheries. The French and Spanish developed surface tuna fishing off West Africa. French tuna vessels operating from the west coast of France fished as far south as 20°S latitude off West Africa and seaward more than 300 miles offshore. Spanish boats operated in nearly the same areas as did the French.

During this period of rapid expansion in tuna fisheries all over the world, a great deal of concern was generated over the potential production that might be derived from the sea. There was also a growing concern on the part of both nations and industries over the continued viability of the tuna stocks. Out of this concern international organizations for tuna research and management were created. These organizations were delegated various degrees of responsibility for the scientific study and management of tuna. An organization called International Commission for the Conservation of the Atlantic Tunas (ICCAT) was formed among countries having an interest in the tuna of Atlantic Ocean.<sup>30</sup>

A convention for the establishment of ICCAT was drafted and signed in Rio de Janeiro in 1966. Seven ratifications were necessary to bring the convention into force, and the seventh country ratified during 1969. The ICCAT convention is open for signature by any government which is a member of the United Nations, or any of its specialized agencies. The convention waters comprise all waters of the Atlantic Ocean, including the adjacent seas.

The commission has responsibility for the study of the populations of tuna and tuna-like fishes (the Scombriforms with the exception of the families Trichiuridae and Gempylidae, and the genus *Scomber*) and such other species of fishes exploited in tuna fishing in the convention area which are not under investigation by another international organization. Each of the contracting parties is represented in the commission by not more than three delegates, who may be assisted by experts and advisors.

The convention provides that, except as may be otherwise indicated, decisions of the commission are to be made by a majority of the contracting parties and that two thirds of the contracting parties constitute a quorum. Regular meetings are provided for once every two years.

The convention of ICCAT provides for research to be accomplished through three avenues: (1) utilization of the technical and scientific services of official agencies of the contracting parties and their subdivisions, and/or (2) utilization of the available services and information of any public or private institution, organization, or individual, and/or (3) independent research (within the limits of its budget) not accomplished under (1) and/or (2) above.

To carry out the objectives of its convention ICCAT may establish panels on the basis of species, groups of species, or geographic areas. Presently, the commission has established four panels: (1) tropical tunas-yellowfin and skipjack; (2) temperate tunas (north)- bluefin and albacore in the northern hemisphere; (3) temperate tunas (south)- bluefin and albacore in the southern hemisphere; (4) other species-bigeye, bonito, billfish and others. Such panels shall be responsible for monitoring the populations of fish under their purview and the collection of information to do so, and for proposing to the commission, on the basis of scientific evidence, recommendations for joint action by the contracting parties. The commission, in turn, on the basis of scientific evidence, may make recommendations to the contracting parties, designed to maintain the populations of tuna and tuna-like fishes that may be taken in the convention area at levels which will permit the maximum sustainable catch.

Others are the Inter-American Tropical Tuna Commission, and the Indo-Pacific Fisheries Council. The latter two fall within the framework of the Food and Agriculture Organization (FAO) of the United Nations.



The objectives of these organizations have to do with the conduct of research on the tuna stocks of the world and on the fisheries that exploit them. The results of this research are used in assessing the effect of exploitation on the condition of the stocks being exploited. Only two of the organizations, IATTC, and ICCAT, have actually recommended and implemented management measures for the species within their areas of responsibility.

In 1972 ICCAT recommended a minimum size limit on yellowfin tuna of 3.2kg (7 pounds). This was followed in 1979 by a recommendation for the same minimum size limit on bigeye tuna. The latter limit was set because of confusion in differentiating small yellowfin from small bigeye.

### ***Effects of current regulations***

(i) Yellowfin tuna -- Juvenile yellowfin of less than 3.2 kg. are caught in large numbers in the tropical east Atlantic, often in mixed schools with skipjack and small bigeye tunas. In 1978, ICCAT adopted a regulation to reduce the catch of juvenile yellowfin in order to increase the yield per recruit of the stock. This regulation has had only minor effects on the fisheries, and in general is ineffective in reducing fishing mortality on juvenile yellowfin. A considerable number of juvenile yellowfin are still being landed.<sup>31</sup>

According to ICCAT, fishing effort exerted on the east Atlantic stock was too high from 1981 to 1983. A change took place in 1984 with the departure of majority of the purse seiners. This caused fishing effort for 1984-85 to be at a level near the optimum with the present exploitation scheme. Although it seems that the stock is recuperating rapidly, there is a risk that effort again may reach very high levels if the purse seiners return. With the intensive exploitation which peaked in 1982-83, the efficient application of such a regulation would bring significant gains in yield per recruit.

The decrease in effort mentioned above lessens, or even nullifies the benefits of the regulation. However, the extreme mobility of the purse seine fleet can cause a very sharp rise in this effort, thus returning the stock to the situation where the regulation could have positive effects if it is correctly applied.<sup>32</sup>

(ii) Bigeye tuna --- The bigeye minimum size regulation of 3.2 kg., with an allowable catch of 15%, has been in effect since 1980. The purpose of the regulation is (1) to reduce fishing intensity on juvenile fish so as to increase the yield per recruit, and (2) to avoid the misreporting of the catch of small yellowfin tuna, on which the same size limit regulation as that for bigeye tuna has been enforced since 1973.<sup>33</sup>

Sampling of yellowfin and skipjack unloaded in Puerto Rico after transshipment from the east Atlantic continued to show that such shipments include large numbers of small bigeye that are not being identified separately. Furthermore, sampling in African ports of catches from the surface fisheries in the east Atlantic shows that bigeye smaller than the minimum size are still being landed in proportions greatly in excess of the 15% tolerance by number that is permitted by the regulation, because these small bigeye tuna are caught mixed with skipjack and yellowfin tunas. This implies that the regulation has not been functioning desirably, and has been unable to decrease the fishing on young fish. Therefore, the expected increase in yield per recruit is unlikely to have been obtained, although such an increase would not have been large.<sup>34</sup>

(iii) Skipjack tuna --- No regulations exist or are recommended for skipjack. Current regulations on yellowfin and bigeye do not seem to be affecting skipjack catches. Management measures are neither needed nor desirable for Atlantic skipjack. Skipjack are underexploited and catches can be increased. Increasing fishing effort is the only way to increase skipjack yield per recruit.<sup>35</sup>

(iv) Small tunas --- There are currently no ICCAT recommendations in effect on small

tunas. It is possible that the minimum size regulations now in force for yellowfin and bigeye tunas could have some effects on small tuna catches, since several species occur in mixed schools with yellowfin and bigeye. There exist presently, no recommendations for management of small tunas.<sup>36</sup>

Numerous regulatory techniques have been proposed as methods of limiting catch and/or distributing the benefits from world tuna resources. These include overall catch quotas, national quotas, direct effort limitations, licensing and taxation. Also, various institutional arrangements for carrying out these techniques have been advanced. Examples are extended coastal state jurisdiction or economic zones, regional coastal authorities, regional high seas commissions, and a global management agency.<sup>37</sup>

With tuna as with most fish resources, the concept of benefits to be gained may differ substantially among states. These benefits include but are not limited to :-

Income and employment gained in harvesting tuna.

Income and employment gained in processing or transshipping tuna products.

A source of protein as a consumption item.

Foreign exchange gained through the export market.

Possible payments or rent to be gained through licenses or taxes.

A trade-off item through which to obtain benefits in areas such as concessions relative to international trade of other products; access to marine minerals, military objectives, or other fish species.<sup>38</sup>

### ***Alternative Regulatory Techniques***

(i) Overall Catch Quotas --- While this may be an effective short-term method to prevent immediate overexploitation of a fish population, the waste generated through overcapitalization in the race to catch as much as possible before the quota is reached precludes this technique from consideration as a viable or acceptable long-term approach



by the world community. This would probably tend to restrict the tuna catch primarily to those countries currently involved in tuna harvesting.<sup>39</sup>

(ii) National Quotas --- Under this approach the total permissible yield would be determined and then divided among the relevant nations. They would be given national quotas which they would agree not to exceed. These quotas could be set by species and/or by area. Theoretically, this approach would permit each state to adopt whatever objective it chooses, such as maximum employment or maximum economic efficiency. An overall catch limitation for each tuna species in each area, subdivided among nations, could effectively maintain a high sustainable yield and at the same time prevent economically wasteful competition among the states.<sup>40</sup> Other important questions raised by this approach include how to allow for new entrants to the fishery; and how to distribute the benefits among states other than those actively engaged in the fishery. If national quotas for tuna were based only on historical catch, the number of states sharing in the major part of the benefits would be quite limited.

Additionally, proximity, which may be a useful criterion for allocating quotas for certain coastal species, does not seem to be an appropriate sole criterion for allocating the quota or benefits from highly migratory species such as tunas. If national quotas are established, it is important that these quotas be marketable. This would help to assure that the quotas are available to the most efficient or lowest cost producers. Allowing for the transfer of quotas among nations would also help to solve the problems of how to allow for new entrants to fishery (Saila and Norton, 1974).

(iii) Direct effort limitations --- Through these, a determination would be made of the allowable catch by species or area, and then an estimate of the number of standardized units of effort necessary to take this catch would be made. The total allowable effort would then be allocated among the fishing states. This technique could overcome the economic waste from overcapitalization that would result from national and overall catch quotas.

The questions of how the effort is allocated among states, how to allow for new entrants, and how, if at all, the benefits can be shared by non-tuna fishing states have to be answered. There are additional complex issues involved with this technique. In tuna fishery, different types of fishing methods are used - principally longlining, purse seining, and bait fishing. To effectively restrict effort, a standardized method of measuring effort would have to be developed and applied against each vessel in the fishery. Also, adjustments would have to be made for changes in fishing effectiveness, such as improved search or spotting methods. One potentially serious shortcoming of direct effort restrictions is that they may tend to retard technological advancements. If technological improvements are made, the management agency, in its attempt to keep effective effort at a given level, would have to reduce the allowed effort, with a possibility of no real gain to the vessel owners.<sup>41</sup>

(iv) License fees and taxation --- License fees or taxation can be used to appropriate revenue for financing the management agency, for payment to coastal states for allowing fishing in their jurisdictional waters, and/or for distribution to non-tuna fishing states while at the same time serving as a means for controlling the catch of a particular species. For example, license fees or landings taxes, if set high enough, could artificially raise the cost of harvesting to a point where additional fishing effort would not be profitable. Then, by requiring each vessel to pay an appropriate fee either through (1) a license fee based on vessel size, (2) a license fee that allows for landing a certain amount of fish, or (3) a direct tax on landings, the management agency or the coastal state could limit catch, because those unwilling to pay the fee would not enter the fishery.<sup>42</sup>

The collection of a tax or license fee will not result in an increase in world tuna prices. Rather, this is a method for extracting rent that would accrue to individual vessel operators if fishing effort were limited, or for extracting revenue that would be dissipated in the form of higher costs due to overcapitalization if effort were not limited.<sup>43</sup>

Without an effective worldwide management program, the major tuna species will in the relatively near future probably be exploited at levels beyond the maximum average sustainable yields. However, a worldwide management agency that can appropriately take into account the various objectives of all nations can not be achieved quickly. Any economic zone alternative without rational high seas tuna management regulation will not prevent excess effort and the associated biological and economic waste. Also, because of the flexibility and mobility of the tuna fleets, area by area or species by species management plans cannot be effective over time. Certainly piecemeal regulations by regional (even oceanwide) commissions acting independently will not bring about desirable results.<sup>44</sup>

I believe the best management measure should be the combination of national quotas and direct effort limitations. This will be in the interest of the developing countries of West Africa presently taking part in tuna fishing and the new entrants too, as it will control over-exploitation by the larger and more sophisticated fleets of the advanced nations. Also, each participant will be assured a fair share of the tuna resources. This measure may not be totally acceptable to some of the advanced nations fishing in the east central Atlantic region, however, taking the interests of the poor developing nations of the West African region into consideration, this price is not too high. This measure is also in accordance with the terms of the third United Nations Convention on the Law of the Seas.

## 6. *International Tuna Market*

Tuna is an expensive commodity and in many less developed countries is too costly to compete with other cheaper products as a source of foreign exchange. Tuna is caught, shipped and sold in all parts of the world. It is certainly an international fishery with a world market. The catching, processing and marketing of tuna has grown to major importance in the world's fishing industry during the past decades. Demand for tuna products on the world market is strong and rising each year, especially in the United States, Japan, and Western Europe. This demand will be met by developing presently underutilized resources, especially those in the Indo-Pacific waters of South and South east Asia.

Tuna and tuna-like fishes are classified by physical characteristics and by their market value, based on consumer acceptance of the raw or processed product. Statistics on the annual world catch of tuna generally include the landings of bonito, frigate mackerel, little tuna, and various tuna-like scombriforms, which are close relatives biologically, but not in an economic sense. When examining the economics and marketing of tuna on a world basis, it is essential to recognise that there are three groups of species of tunas, based on their use and market value.

White - meat species : Albacore (*Thunnus alalunga*) This is the only species that can be sold in the American market as white meat. In the United states, which utilizes about 80% of the world production, as well as France and Spain, albacore commands the highest price of all tunas because of its high yield (cases of canned product per ton of raw material) and consumer preference for white meat.<sup>45</sup>

(ii) Light - meat species : Yellowfin (*Thunnus albacares*), Skipjack (*Katsuwonus pelamis*), Bluefin (*Thunnus thynnus*), Southern bluefin (*Thunnus maccoyii*), Longtail (*Thunnus tonggol*), Bigeye (*Thunnus obesus*), Little tuna or black skipjack (*Thunnus*

atlanticus), Slender tuna (*Allothunnus fallai*), and young tunas (juvenile bluefin and yellowfin). These species may be canned and sold under the light-meat tuna label in the United States and European markets. Value, by species, is related to labor cost, product yield and quality, all of which vary with fish size. In the United States, skipjack, the smallest species, sells for about \$55 per ton (round weight) less than domestic caught yellowfin. Large yellowfin, bluefin and bigeye (45 kg. or larger) often produce a very dark canned product which is not acceptable on the United States market. These fish are sold at discount prices to American canners or find a ready market in Italy or Japan. Black skipjack also makes a product unacceptable in the American market because of its dark color and strong taste.<sup>46</sup>

In Japan, sashimi (which is eaten raw) is the premier product of the tuna market. Bluefin is the preferred species for these products and command very high prices; bigeye and yellowfin are next in preference. These three species (along with young tunas and albacore, the latter of which is mostly exported due to a general consumer rejection of white-meat tuna) make up the commodity "tuna" in the Japanese market. Skipjack, which is consumed primarily as "Katsuobishi" (a smoke-dried product), but also as sashimi, is generally considered separate from "tuna" in Japanese market formulation.<sup>47</sup>

(iii) Tuna-like species --- Bonito (*Sarda sarda*, *Sarda chiliensis*) and Frigate mackerel (*Auxis thazard*, *Auxis rochei*). They both make an acceptable canned product, but because of labelling laws, cannot be labelled as tuna in the United States and most of Europe; world market prices for these species are therefore much lower than for the light-meat tunas.

### ***Major products***

(i) Fresh and Frozen tuna --- Fresh tuna is of little importance in the import/export business. Most tuna which moves through the international trade system is in a raw



frozen condition. Some cooked loins, canned tuna and dried tuna are marketed internationally. However, the tonnage is minor compared with the fresh/frozen fish trade. The modern pole and line, and purse seine vessels freeze their catch in brine and dry store the fish in a round condition. Longline catches undergo some preliminary processing prior to freezing : yellowfin and bigeye have the gills and viscera removed; sometimes the fish are headed to conserve space. Longline-caught tuna are usually large and are not taken aboard the vessel at a rapid rate. Therefore, they receive great care in handling and freezing and because of their superior quality command a higher price than purse-seine- or pole and line-caught tunas.<sup>48</sup>

Regardless of the freezing system used - brine spray, brine emersion, blast freezing or other- the continuous maintenance of low temperatures is required to sustain a high quality product for the processor. Tuna are seldom purposely thawed prior to reaching the cannery or the retail market. Frozen tuna are transshipped on bulk carriers or in cold storage containers. The container method is becoming very popular except where large loads are concerned. Small shipments usually go by containers if facilities are available. In the United States as well as Europe, frozen tuna are usually processed in a coastal city and then transported in the canned form to the national markets. Tuna in Japan most often reaches retail markets in a raw fresh or frozen condition.<sup>49</sup>

(ii) Canned tuna --- In the United States, tuna is machine-packed in one of four different styles: solid, chunk, flake or grated. For the solid style, a machine (designed especially for the tuna industry) shapes and compresses tuna loins into cylinders and then cuts them to size. For chunk-style, the loins are cut into bit-size pieces prior to packing. The flake and grated packs are composed of smaller and irregular pieces of tuna which do not meet the size standards for chunk pack. The United States market for white meat is predominantly solid pack while that for light meat is largely for chunk pack. The standard or preferred can size in the American market, which dominates canned sales, is the 6-1/2

(chunk pack) or 7-ounce (solid pack) tin. Nearly 70% of the United States pack is in the standard can size, often termed the "1/2 pound" can. Other popular size cans are 3-1/4 ounce or "1/4 pound", 9-1/4 ounce or "3/4 pound", 13 ounce or "one-pound", and the 66-1/2 ounce or "four pound". The smaller sizes are sold in the retail market, while the one and four pound packs are for the institutional trade (restaurants, schools and cafeterias).<sup>50</sup>

To enhance the flavor of the tuna meat, a variety of condiments may be added during the canning process. In the early 1940's, the United States tuna industry discontinued the use of cotton seed oil and substituted soya oil, which remains the primary additive used in canned tuna. Other packing mediums which may be used if properly labelled are any vegetable oil, olive oil, brine, water and for speciality packs, vegetable broth, spices and spice extracts or oils. Tuna may be seasoned with salt and certain FDA-approved preservatives such as monosodium glutamate. In Europe, condiments preferences vary by country. French consumers prefer vegetable oil, brine and tomato sauce packs. Italians prefer their tuna packed in olive oil, as do the Spanish; however, Spanish consumers purchase notable volumes of canned tuna in vegetable oil, brine and tomato sauce.<sup>51</sup>

Tuna which moves through international trade channels is most often either frozen raw or canned. Some trading in fresh and dried tuna as well as cooked tuna loins and other specialty items occur, but the volume is minor in comparison with frozen and canned products.

Frozen raw tuna is the primary tuna trade item for several reasons. To preserve the fish, modern tuna fishing vessels freeze their catches shortly after they are taken aboard; the fish remain frozen until reaching the processor's plant or the retail market. Fishing vessels are thus able to transfer their catches to a refrigerated carrier, into a cold storage box at a port of convenience for later shipment, or unload directly to the processor or handler. Tuna transshipments are handled on a routine basis by trading companies,

commission brokers or by direct contract with the processors or retail marketing agents. Another consideration is that most countries prefer to process their own fishery products; importation of the raw material rather than the finished product is preferred. This provides local employment, tax revenue, better control over quality and sanitation conditions, and quicker response to consumer preferences, sales and inventory movements. Frozen raw tuna has relatively free access to the principal world markets, while canned tuna is more restricted. as to the number, size and type of markets it may enter, a result of national trade barriers, economic conditions and local eating habits.

Consumers in the United States and Western Europe utilize mostly canned tuna, while the Japanese prefer their tuna raw, spiced or in a dried form. However, canned tuna usage in Japan is on the increase, primarily because it is a convenient food; heavy inventories of canned tuna periodically accumulated by Japanese packaging companies have also encouraged local marketing.<sup>52</sup>

### ***Mechanics of the Market***

There are two main types of marketing systems or distribution procedures used in the United States: the broker system and the processor-owned marketing system. Some processors use one method or the other, while some utilize both systems. Brokers represent the processor in maintaining contact with large lot buyers, wholesalers and retail food chains. The brokers make the sales, forward the order to the processor, and receive a commission based upon the value of the goods sold. Most canned tuna is sold through the food broker system.<sup>53</sup>

Most non-brokered sales are made by the processors' direct sales force. They are primarily concerned with the distribution of products, sales promotion and advertising work but make direct sales for special customers or select markets.

There are other types of wholesale distribution systems or organizations performing similar services that handle the wholesale marketing of canned tuna. These include retail owned cooperatives, independent wholesalers, chain store warehouses, military and government buyers and others. The quantities or volumes of tuna sold through or to these groups vary considerably depending upon availability of product, sales volume of the organization and seasonal sales promotions by the canners.<sup>54</sup>

Most of the money and effort expended in the marketing of canned tuna in the U.S. is in the retail trade. Promotions, market surveys and advertising campaigns are usually directed toward the consumer. Institutional sales are most often carried out through direct orders from the buyers to the processors. Retail sales are made through two separate marketing procedures: private label and advertiser's or processor's brands. Processor branded merchandise yields the best margins. Packers thus favor their own labels in terms of quality of pack and promotional support. Private label business is usually a volume operation with low margins and little label loyalty. It provides increment volume to support processor overhead. Some U.S. processors pack under foreign label for sale in the U.S. and overseas.<sup>55</sup>

Most national advertising for tuna products is done by the processors for their name brands; consequently most of the canned tuna sold on the retail market is the advertisers' brands. There is heavy sales competition among the advertised brands. Retailers who maintain own store brands (private labels) also carry the processors' advertised brands; name-brands usually sell at slightly higher prices than private label brands. American processing plants are concentrated in Puerto Rico and American Samoa. However, the major tuna processors maintain warehouses, not only at processing sites, but also near primary market regions. Adequate inventories of leading sales items are maintained within fast delivery range of major customers. The distribution system is large, complex and expensive to operate, primarily because of the great geographic distances from the

plants to the heavy population centers.<sup>56</sup>

Canned tuna is a staple food item in the American market, and as such is subject to strong competition from beef and poultry products. Consumer purchases of canned tuna are particularly sensitive to price relationship between tuna, other seafoods, beef and poultry products. This characteristics makes prognostication especially difficult.

The Japanese annually produce far more tuna than can be consumed domestically and thus are the world's largest exporter of frozen and canned tuna products. The United States and Western Europe are their primary consumers. Japan has the highest per capita consumption of the major tuna consuming nations, at nearly 4 kg. during 1973 and 1974. Consumption is oriented towards the traditional sushi and sashimi (raw fish) as well as dried fish sticks (bushi). The Japanese produce a large amount of canned tuna for export to the United States (primarily albacore in brine) and to Western Europe (primarily light meat in oil). Domestic usage of canned tuna is minor compared to the other tuna products but demand has increased considerably in recent years.

The premier tuna product consumed in Japan is fresh, raw, sliced tuna (sashimi). It is usually a leading item on the menus of all Japanese-style seafood restaurants. It is sold by thousands of fish peddlers and seafood markets and is now displayed in supermarkets and even in some department stores. Sashimi-grade tuna is retailed in the form of small blocks or a size suitable for cutting into thin slices. Bluefin, bigeye, yellowfin and skipjack, preferred in that order, provide most of the sashimi raw material. Bluefin is used exclusively for sashimi while only the top grades of bigeye and yellowfin tuna, as well as some albacore, go into the sashimi market. Although the least preferred, skipjack sashimi is growing in popularity due to its lower price. Skipjack supplies have expanded rapidly in recent years while supplies of the preferred sashimi species, especially bluefin and bigeye, have stagnated.<sup>57</sup>



Japanese sashimi gourmets insist on top quality fish. Tuna destined for the sashimi market receives special handling; cold storage plants in Japan which handle sashimi tuna utilize super-cold freezer sections. A large transportation and storage system of refrigerated trucks, railcars, and local freezers has developed in the ports and major population centers throughout the country. Retailers usually thaw the fish before sale, but some maintain freezers. Approximately 97% of the households in Japan have home refrigerators today. With the development of the cold storage chain, seafoods which were formerly eaten mostly in coastal cities are now consumed throughout the country. This has been a key element in the rising demand for tuna.<sup>58</sup>

Most of the balance of skipjack supplies (not utilized as sashimi or katsuo-bushi) as well as middle-grade bigeye, albacore and yellowfin tuna, are canned-primarily for export, or exported as frozen product. Japanese usage of canned tuna, while still minor, is growing rapidly as rising consumer incomes stimulate use of convenience products.<sup>59</sup>

The marketing of tuna and other seafood products in Japan, along with other perishable foodstuffs, is based on an extensive system of regional and branch wholesale markets. The municipal or local governments usually operate the system and lease space to wholesalers. Supplies are obtained from producers, brokers and shipping agents and brought into the market by wholesalers. Wholesalers sell through a bidding or auction process to middlemen or other authorized dealers who trade directly with retailers, processors, institutional buyers and local markets. The local marketers usually purchase their needs daily.

Prices for tuna in Japan vary according to the consumer market for which the product is destined. Tunas selected for the sashimi market command very high prices, while tunas chosen for export or processing sell for lower prices. Sashimi fish must be of the highest quality; handling requires special knowledge of modern freezing and preservation techniques which the Japanese have mastered. Tunas not considered sashimi quality are

usually sold to domestic canners or processors, or are exported to other countries.<sup>60</sup>

Value differences among species are related to quality, market preference, fish size, the resulting yield during processing and labor costs. In Japan, large high-quality bluefin tuna is the preferred species for sashimi and, therefore, brings the highest price on the fresh fish market. Large bigeye and yellowfin are next in order of preference but sell for about one-third the price of first-quality bluefin. Skipjack for canning or for export is at the low end of the tuna value on the Japanese market.(Figure 4)

The world's third largest market for tuna and tuna products is Western Europe. The principal producing countries are Spain and France and the leading consuming nations are France, Italy, Spain, Federal Republic of Germany and the United Kingdom. Other tuna using nations are Switzerland, Portugal, Denmark, Belgium, Luxembourg and the Netherlands, however usage of these latter countries is relatively minor. West Germany and United Kingdom import their tuna in the canned form, mainly from Japan, Taiwan and Peru; they have neither tuna packing facilities nor tuna fishing fleets. France and Spain have their own fishing fleets and tuna canning plants. Italy has a large tuna canning industry but relies almost entirely on imports of frozen tuna for raw material to operate the plants. Italy and Spain produce enough canned tuna to maintain a good export market. Europe, like the United States, consumes most of its tuna in the canned form.<sup>61</sup>

The Japanese have been the primary exporters of frozen and canned tuna to Europe. However, their dominance of the European market has been deteriorating in recent years. The rising cost of Japanese products along with the mercury "scare" in 1971, and more recently the large buildup in the tuna fleets of Spain and Italian canned tuna is now moving into the West German and British markets to compete with Japanese products. The Taiwanese have also entered the West German market by putting chunk style tuna in oil on the shelves at prices below those of comparable Japanese product.<sup>62</sup>

SPECIES NAMES	PRODUCT FORM & GRADING	INDICATIVE PRICES in JPY/kg & USD/mt	PRICE REFERENCE & MARKET AREA	ORIGIN
<b>FOR SASHIMI AND OTHER FRESH USES</b>				
	Chilled, G&G by air	+JPY2900-3500 USD18776-22661/mt	Auction Tsukiji market, Japan	Taiwan PC Philippines
	Frozen un/10 kg/pc 10-15 kg/pc 15-25 kg/pc 25-40 kg/pc 40 kg & up/pc	#JPY 270 1748/mt #JPY 458 2965/mt #JPY 578 3742/mt #JPY 850 5503/mt #JPY 1258 8145/mt	Auction Tsukiji market, Japan, caught by sashimi longliner	Mid-Indian Ocean
	Fresh, 40-50 lb/pc 80 lb & up/pc	6820-13090/mt- 9680-16280/mt-	Auction, Hawaii, USA	-
	Chilled, G&G, by air	#JPY 700-2500 USD4532-16186/mt	Auction Tsukiji market, Japan	Philippines /Taiwan PC
IN es	Frozen un-10 kg/pc 10-15 kg/pc 15-25 kg/pc 25 kg & up/pc	#JPY 240 1553/mt #JPY 374 2421/mt #JPY 619 4007/mt #JPY 707 4577/mt	Auction Tsukiji market, Japan, caught by sashimi longliner	Mid-Indian Ocean
	Fresh, 80 lb & up/pc	7480-11770/mt+	Auction, Hawaii, USA	-
	Fresh, 30-150 lb/pc 100-300 lb/pc	4400-8250/mt# 2200-7700/mt#		
	SH Fresh, whole	13200/mt	Wholesale, New York USA	Ecuador
<b>FOR OTHER PRODUCT FORMS</b>				
E a	10 kg & up/pc	#JPY 220-230 USD1425-1489/mt	Shimizu market, Japan landed by longliner	S.W.Pacific
	Rd	1480/st	Ex-longliner, A Samoa	Korea
K us	Rd, un-1.5 kg/pc 1.5-2.5 kg/pc 2.5-4.5 kg/pc 4.5-up kg/pc	-JPY 115 790/mt #JPY 140 906/mt -JPY 135 874/mt -JPY 135 874/mt	Shimizu market, Japan	S W Pacific
	Rd	730/mt	c&f Thailand	-
	Rd, 7.5 lb/pc 7.5-20 lb/pc	590/mt# 680/mt#	fob Ecuador	Ecuador
	Rd, un-10 kg/pc 10-up kg/pc	#JPY 185 1197/mt #JPY 210 1360/mt	Shimizu market, Japan	S W Pacific
	Rd	1300/mt	c&f Thailand	-
IN es	Rd, 10kg & up/pc	1100-1120/mt 1276-1453/mt	cif Italy	Pacific Ocean Atlantic/ Indian Ocean
	Rd, 7.5-20 lb/pc 20lb & up/pc	680/mt# 840/mt#	fob Ecuador	Ecuador
	Rd	960/st	Ex-longliner, A.Samoa	Korea
	Rd, fresh	#FCFA 120 370/mt	Auction, Abidjan, Côte d'Ivoire	Côte d'Ivoire
	Rd	400/st	Ex-longliner, A.Samoa	Korea

French purse-seiners, and some of the baitboats, fish mostly off the coast of West Africa and usually transship their fish at Dakar (Senegal) or Abidjan (Ivory Coast) to canneries in France, Puerto Rico and Italy.<sup>63</sup>

Spain has recently become Europe's largest tuna producing nation. Spain's domestic tuna market for fresh/frozen and canned products is not large enough to absorb total national production. Therefore, the Spanish have developed a sizeable tuna export trade. Spanish imports came primarily for the Canary Islands (Japanese and Taiwanese longline fish) and Angola; most of this fish was subsequently exported to European Economic Community (EEC) countries or Puerto Rico. The preferred species for fresh consumption in Spain are the locally caught albacore and bluefin tunas. About 80 percent of all the tuna landed for domestic usage goes to the canning industry.

Through the EEC, trade restrictions between member nations are being minimized while barriers against non-member nations are being strengthened. This, of course is encouraging intra-European trade. Italian production, formerly too high-priced, has begun to replace Japanese and Taiwanese canned tuna in some EEC countries. As the EEC continues to grow in population and as policies change to meet demands of its members, the structure of the market will continue to change. However, national preferences and tastes for certain species of tuna and condiments or additives should remain basically undisturbed. In France, retail markets are the prime movers of tuna products and accounted for nearly 62% of all tuna sales in 1974. The remainder is packed for the institutional trade or sold fresh as steaks in the fresh fish market and restaurants. Frozen tuna for direct consumption or for export is handled almost exclusively by the national cooperative or central agency called SOVETCO (Societe Pour la Vente de Thon Congele). Canneries wishing to import tuna do so through COFICA (Comptoir Francais de l'Industrie des Conserves Alimentaires), a national purchasing agency. Central purchasing houses or offices which handle canned tuna products buy directly from the canneries or from

importers. They supply the wholesalers, supermarket chains and small retailers.<sup>64</sup>

In Spain, frozen tuna imports are purchased directly by individual canners or groups of canners instead of through brokerage agents. Some cold storage companies buy tuna on a speculative basis for later sale. Spain still relies heavily on numerous small retail distributors rather than a large, modern supermarket system.<sup>65</sup>

Frozen tuna has a relatively free access to most of the world's tuna markets and therefore prices in Europe are generally a reflection of the price trends in Japan and the United States. The imposition of large temporary or fluctuating duties on imports, along with price control systems installed by the various individual nations and/or the European Economic Community, seriously affects wholesale and retail market prices. Because of these added costs, prices of canned tuna on the shelves of supermarkets and stores in Europe are higher than those in the United States or Japan.<sup>66</sup>



***Discussion (Feasibility of Nigeria's Participation).***

The Exclusive Economic Zone of Nigeria declared in October 1978 covers an estimated area of 246,000 km.<sup>2</sup> The Nigerian Institute for Oceanography and Marine Research (NIOMR) was given the statutory function of identifying the living resources within the EEZ with a view to assessing their potentials and determining their economic importance for national exploitation and conservation. NIOMR therefore commissioned a survey of resources in the EEZ in April 1982.<sup>67</sup> Documentation of tuna catch rates with time and space as well as the availability of bait fishes in Nigerian waters was among the principal objectives. The method employed in the Tuna Resources survey is bait fishing with a pole-and-line vessel. A total of eight separate cruises were made during the project. The eight cruises covered the entire Nigerian EEZ.

The results of the survey indicate significant concentrations of skipjack tuna located throughout the Nigerian EEZ. Very high concentrations were located near the Principe Island, 45 nautical miles due west of Burutu, and within a 10 nautical mile area of Lagos.<sup>69</sup> The skipjack catch per day averaged 4.8 metric tons per day. This catch rate is comparable to those made by bait boats fishing outside the Nigerian EEZ supporting the theory that the tunas inside and outside the EEZ are of the same stocks, and that stock densities are probably comparable.<sup>70</sup>

The yellowfin stocks in the eastern Atlantic are fished at a very high level and higher catches are not anticipated in the near future. According to the report of the survey based on a realistic but perhaps conservative projection, a first-order approximation of the safe potential annual harvest of yellowfin is 1300 metric tons per year, with a range from 450 to 3500 metric tons per year. Good catches were made near the Islands of Sao Tome and Principe. Significant quantities of yellowfin were also located due south of Palm Point and Koko approximately 6 nautical miles offshore.<sup>71</sup>

Bigeye tuna constitutes only a small portion of the total catch of the bait boats fishing in the EEZ. The catch of bigeye tuna by the survey vessel was quite low and constituted only about 3% of the total catch. The total safe potential annual harvest estimate is about 1700 metric tons.<sup>72</sup>

Within the Nigerian EEZ, small tunas and tuna-like species are found generally closer inshore than the larger yellowfin, skipjack and bigeye. This places them within the range of the artisanal fishermen and represents a good possibility of developing a local market for these species. In the industrial tuna fisheries, many of the small tunas and tuna-like species, i.e. little tuna, frigate mackerels, and others are often taken as by-catch with the larger-sized yellowfin, skipjack and bigeye tunas. The by-catches are usually discarded at sea as undesirable species because of lack of market demand at both local and international levels. Because Nigerians have only just been introduced to these fishes by the survey, a research program in conjunction with a sociological market survey to determine the most satisfactory ways to process, prepare and serve these species should continue.<sup>73</sup>

The interim conclusion of the survey is that a local skipjack fishery if implemented will meanwhile be dependent on bait sources outside Nigeria. Only a few species of small fish have been found satisfactory as skipjack bait. Research is still being carried out to locate more species of bait fish. There appears to be sufficient justification for developing a tuna fishery in Nigeria based on the combined estimated potential yields of skipjack, yellowfin, bigeye and other tuna.<sup>74</sup> Though the world market price for tuna is currently depressed, it is anticipated that as the world economic situation improves, the price of tunas will continue to increase to former levels and beyond.<sup>75</sup>

NIOMR recommends that exploratory seining operations be carried out in the Nigerian EEZ. Comparisons between catch and cost per ton of the purse-seine and pole-and-line would then determine the most efficient and economical fishing method that should be

employed by the locally based fishery. Purse seining is practicable in the Gulf of Guinea because the water is turbid and the thermocline is relatively shallow (30-40 meters). Tuna purse seine nets average 1400 meters long and 200 meters deep.<sup>76</sup>

According to the report of the Federal Department of Fisheries, Nigeria (1984), a suitable reconditioned vessel can cost about US \$400,00 (1982) while anew one can cost between US \$600,00 and \$1 million depending on size and gross tonnage. A vessel can operate for ten trips in a year catching about 1404 metric tons. The estimated total annual income is about US \$953,950.19 therefore, the estimated annual net profit is about US \$43,023.26 per vessel. A company operating 5 vessels should make an estimated annual profit of US \$215,116.30.<sup>77</sup>

The tremendous pressure on world fisheries exerted during 1960s and 1970's by distant-water fishing fleets such as those of the U.S.S.R., Japan, the United Kingdom, and the United States, engendered increasing international tensions, a variety of conflicts, and led to strong pressure within a number of states, mostly but by no means all developing states, for wider exclusive national fishery zones. The creation of the EEZ is a clear manifestation of this growing pressure. While recognizing the singular and dominant role, rights, and responsibilities of the coastal state in the management and conservation of the living resources in the EEZ, the new Law of the Sea Convention seeks to provide some recognition of the fishing interests of other states.<sup>78</sup>

In distributing any possible surplus, the coastal state is to take into account: all relevant factors, including, inter alia, the significance of the living resources of the area to the economy of the coastal state concerned and its other national interests, the provisions of articles 69 and 70 (pertaining to the rights of landlocked states and states with special geographical characteristics), the requirements of developing states in the sub-region or region in harvesting part of the surplus and the need to minimize economic dislocation in states whose nationals have habitually fished in the zone or which have made substantial

efforts in research and identification of stocks.<sup>79</sup> The new Law of the Sea Convention also calls for international cooperation through appropriate international organizations in regard to stocks within the EEZ shared by two or more coastal states, stocks occurring within the EEZ and beyond and adjacent to the EEZ, highly migratory species, and marine mammals. In practice, fishing in foreign EEZs has come to be governed under the terms of a growing number of diverse bilateral agreements (Juda, 1986).

The disadvantages of Nigeria's entry into tuna fishing in the east central Atlantic region include no previous experience in tuna fishery, limited technology and skilled manpower, limited foreign exchange, inadequate shore-based facilities like cold storage and processing plants, and poor communication network. Also, the international tuna market is unpredictable, likewise the catch of tuna in the ocean.

The advantages of Nigeria's participation include a big domestic market, proximity to fishing areas, low labour costs, availability of fuel, docking facilities for general maintenance and repairs of vessels, and great intraregional influence and cooperation.<sup>80</sup> The exit of some Spanish, French, and Japanese boats to the Indian Ocean in 1985 is also to Nigeria's advantage.

## 8. Conclusion

World production of tuna is not anticipated to keep pace with market demand. A share of the major producing areas are already fully exploited. The extension of national jurisdictions (to 200 miles from the baseline from which the limit of the territorial sea was measured) is expected to exclude long-range high seas tuna fleets from certain traditional fishing areas and to increase the costs of access to others. The result will be stagnation in world supplies of tuna during the next few years. Additionally, there will be major changes in who produces the fish. This combination of forces, plus the anticipated growth of demand in the major markets, will cause raw tuna prices to escalate, maintaining strong upward pressure on retail prices in all the major markets. Competition from other protein sources, chiefly beef and poultry, will thus limit market growth.<sup>81</sup>

Locally-based tuna operations in developing areas will benefit from this trend toward higher prices for tuna. The reduced supplies of tuna from traditional sources will create a need for fishing development and market prices sufficiently high to insure commercial viability of projects which are favourably located and properly managed. The best potential for additional tuna catches lies in the development of the surface fisheries for skipjack, yellowfin and longtail.<sup>82</sup>

Fleet profitability remains the key to tuna fishery development. Although the operation of processing facilities and marketing of the products require special knowledge and experience, these can be acquired through joint ventures with companies in industrialized fishing nations like Japan, Spain, and U.S.A. or through the hire of expatriates as consultants. Catch rate, the most important variable in determining fleet success, is related to the abundance and distribution of the capability of fleet management.<sup>83</sup>

It is therefore essential that vessel productivity be examined in detail prior to a major



fishing commitment. If sufficient information is not available concerning the resource from research and exploratory fishing operations and previous commercial ventures, then the development project should be phased so that preliminary investment ( and financial exposure) is minimized. Major capital expenditures for fleet and shore facilities should follow only if the initial efforts are encouraging. Such a course of action is often counter to established policies of lending agencies who do not wish to consider modest expenditures. Nevertheless, fisheries development is unique in this respect and successful development loans require this cautious approach.<sup>84</sup> Project developers tend to be optimistic with respect to the level at which catches can be sustained. Estimates of days at sea and catch per day often do not include allowances for vessel tie-up due to maintenance and repair, crew problems, national holidays and customs, abnormal weather and poor fishing times. Therefore, most investment projects which survive the initial review will require a field visit and preliminary analysis by a trained marine biologist/economist.<sup>85</sup>

Bait fishing requires large, sophisticated and fairly expensive vessels. The operation also requires abundant year-round supplies of live bait. Purse-seining requires the most sophisticated and expensive vessels and gear and are utilized for fishing surface schools of tuna. This method is not suitable generally for use in developing countries where facilities are seldom adequate to handle repairs and maintenance and other support functions. Long-line is employed for the capture of large, deep-swimming tunas.

Processing may be as simple as the storage of whole frozen tuna for transshipment to distant canneries, or as complex as the production of loins or canned product. Freezing, storage, handling, shipping, unloading and port charges, and brokerage for frozen tuna varies greatly depending upon the volume shipped and the origin and destination of the shipment. The production of frozen loins reduces the charges per ton of useful raw material; however, quality problems generally escalate (and rejects increase). Canning required additional capital investment and technical sophistication. The advantages of low-

cost labour are offset by the higher cost of containers and packaging.<sup>86</sup>

Tuna is at the peak of its quality at the moment of capture. Subsequent handling, refrigeration, storage and processing practices determine, to a large degree, the quality of the final consumer product. The small tunas, particularly skipjack, are the most susceptible to deterioration, which can be rapid in a tropical climate unless prompt action is taken to remove heat via ice or mechanical refrigeration. Ice should only be used as a temporary method of preservation (one or two days at most) until the fish can be placed in cold brine or dry freezing facilities. Numerous studies by American tuna processors indicate that rejects (by canneries of frozen tuna) can almost always be correlated with holding of the tuna on board the fishing vessel too long and at too high a temperature in the chilling stage, to physical damage, to fuel or ammonia contamination, to salt penetration or to chemical or bacterial action. Texture, colour, odour and flavour of the canned product are all affected by these factors.<sup>87</sup>

Labeling or marking requirements vary according to customs and food agency regulations in each importing country. The international standardization of information relative to the origin and contents of the packaged fish products is being formulated by the Codex Alimentarius Commission in cooperation with the World Health Organization and the Food and Agriculture Organization; until these standard regulations are put into effect, individual country requirements will remain.<sup>88</sup>

A peculiarity of the East Central Atlantic region's fisheries is that the highest concentration of fish lies opposite the lowest density populations. Almost all the types of fish caught in this region are overexploited or approaching overexploitation so that no large increase in yield can be expected. The solution to this dilemma is slowly being worked out: the fortunate countries with a surplus are being induced to allocate some of it to those, especially in the Gulf of Guinea, with high populations, and future development here would obviously predicate a reinforcement of regional cooperation.<sup>89</sup> There is a need for more

cooperation at the regional level for the effective management and conservation of the tuna stocks.

Since Nigeria needs tuna mostly for domestic consumption in order to reduce the drain on the national treasury by fish importation, the project looks positive. Joint ventures should be set up on a short-term basis, using the relatively inexpensive long-line and bait boat fishing methods. Some Nigerian fishermen should be trained to handle the different tuna fishing gears effectively, and also the management team should be adequately trained. Efforts should be made to develop the local market so that tuna can have wide acceptability to the Nigerian consumers. The venture should be profitable since there is a big domestic market to be exploited, and since the main motive is to conserve scarce foreign exchange.

*Table 1**Total Catch of Tunas by Species (in Metric tons).*

<i>Species</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>
Yellowfin	109,467	123,841	112,889	111,176
Bigeye	30,843	23,294	28,190	28,936
Bullet and Frigate	8,748	3,372	6,601	7,149
Albacore	2,924	3,312	3,109	2,670
Skipjack	88,859	105,750	116,672	111,937
Northern bluefin	1,260	1,297	2,117	1,598
Little tuna	4,776	3,342	5,710	6,608
Plain bonito	697	1,446	760	383
Atlantic bonito	7,641	6,185	7,850	3,848
W. African Spanish mackerel	4,412	1,983	3,833	3,308

*Source:- FAO 1983 yearbook of fishery statistics, Vol. 56.*

Table 2

*Total Catch by Countries (in Metric tons)**(i) Bigeye tuna (Thunnus obesus)*

<i>Countries</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>
Benin	--	40	45	52
Cape - Verde	27	270	110	174
Cuba	1,385	711	520	418
France	3,185	424	1,901	2,583
Ghana	76	122	570	285
Ivory-Coast	231	240	329	321
Japan	8,864	6,162	12,479	12,902
Korea (Republic)	9,099	10,265	8,989	6,863
Panama	3,245	2,002	--	2,636
Portugal	224	--	--	--
Senegal	--	8	40	40
Spain	3,500	2,313	2,493	1,919
Togo	--	--	--	14
Others	1,007	737	714	729
<b>Total</b>	<b>30,843</b>	<b>23,294</b>	<b>28,190</b>	<b>28,936</b>



(ii) Yellowfin tuna (*Thunnus albacares*)

Countries	1980	1981	1982	1983
Benin	--	100	113	130
LIBRARY	769	3,698	3,018	4,356
AFAIRS	5,817	4,942	3,689	2,438
ASTUBEN HALL	39,828	39,547	32,010	24,763
CLASS A	803	2,976	4,387	2,231
CODE NO.	9,847	10,193	8,829	8,604
TITLE	2,265	1,473	4,012	4,148
ABIOYE,	7,523	7,007	5,171	2,658
ADEREMI O.	1,645	263	1,610	1,682
	577	9	16	6
	31	97	193	149
	69	543	887	887
1987	38,683	50,866	48,636	58,799
	884	1,684	--	--
	726	443	318	325
THE EAST	109,467	123,841	112,889	111,176
CENTRAL				
ATLANTIC				
TUNA FISHERY				
ADEREMI O.				
ABIOYE				

COPIES #1 AND #2 TO BINDERY  
COPIES #3 AND #4 TO LIBRARY

*(iii) Skipjack tuna (katsuwonus pelamis)*

<i>Countries</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>
Benin	--	60	68	78
Bulgaria	--	--	--	7
Cape - Verde	1,831	1,419	1,410	1,392
Cuba	171	184	189	135
France	21,409	27,243	25,062	29,611
Ghana	5,615	8,330	18,044	22,404
Ivory-Coast	5,774	5,975	8,310	8,099
Japan	10,488	15,227	11,041	11,416
Korea (Republic)	6,154	4,981	3,407	2,227
Morocco	2,897	156	598	208
Panama	1,735	144	2,541	1,611
Portugal	465	130	90	28
Senegal	67	1,772	1,446	1,446
Spain	30,527	37,917	44,466	33,256
U.S.A.	1,766	2,212	--	19
<b><i>Total</i></b>	<b><i>88,859</i></b>	<b><i>105,750</i></b>	<b><i>116,672</i></b>	<b><i>111,937</i></b>

*(iv) Albacore (Thunnus alalunga)*

<i>Countries</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>
Cuba	56	101	90	56
Ivory-Coast	77	78	128	125
Japan	76	100	86	89
Korea (Republic)	1,208	1,140	1,131	561
Panama	--	--	--	--
Portugal	7	--	--	--
Spain	500	1,009	625	768
Others	1,000	884	1,049	1,071
<i>Total</i>	<i>2,924</i>	<i>3,312</i>	<i>3,109</i>	<i>2,670</i>

*(v) Northern bluefin tuna (Thunnus thynnus)*

<i>Countries</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>
Bulgaria	--	--	--	--
Cuba	--	--	6	--
Italy	29	--	--	--
Japan	752	229	165	171
Korea (Republic)	--	--	--	3
Morocco	155	105	508	275
Norway	--	--	--	--
Panama	117	48	12	--
Poland	--	--	--	--
Portugal	7	391	861	714
Spain	200	524	565	435
Others	0	0	0	0
<i>Total</i>	<i>1,260</i>	<i>1,297</i>	<i>2,117</i>	<i>1,598</i>

*(vi) Frigate and Bullet tunas (Auxis spp.)*

<i>Countries</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>
Benin	--	64	72	83
Bulgaria	3	3	--	7
G.D.R.	--	--	106	55
Ghana	8,039	2,048	6,062	5,632
Ivory-Coast	--	--	150	146
Japan	--	--	--	--
Morocco	706	1,257	211	1,226
<b><i>Total</i></b>	<b><i>8,748</i></b>	<b><i>3,372</i></b>	<b><i>6,601</i></b>	<b><i>7,149</i></b>



<i>Countries</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>
<i>(vii) Little tuna (Euthynnus alletteratus)</i>				
Benin	--	40	45	52
Bulgaria	--	--	--	--
Cape - Verde	--	14	8	1,240
Cuba	131	53	45	0
G.D.R.	--	--	397	543
Ghana	4,233	2,900	4,669	4,338
Ivory-Coast	177	182	150	146
Mauritania	31	86	76	54
Morocco	16	19	29	19
Panama	58	36	--	--
Poland	--	--	--	--
Portugal	121	--	--	--
Romania	9	12	291	216
<b>Total</b>	<b>4,776</b>	<b>3,342</b>	<b>5,710</b>	<b>6,608</b>

*(viii) Plain bonito (Orcynopsis unicolor)*

Mauritania	101	478	99	37
Morocco	596	968	661	346
<b>Total</b>	<b>697</b>	<b>1,446</b>	<b>760</b>	<b>383</b>

<i>Countries</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>
<i>(ix) Atlantic bonito (Sarda sarda)</i>				
Benin	--	32	36	41
Bulgaria	75	8.23	46	
G.D.R.	288	440	146	274
Ghana	77	5	71	66
Greece	0	1	1	1
Morocco	259	477	644	552
Poland	--	--	--	--
Portugal	13	--	--	--
Romania	64	81	249	192
Sao Tome & Principe	33	90	78	103
Sierra Leone	57	30	5	5
Spain	469	500	539	415
U.S.S.R.	6,306	4,521	6,058	2,153
<b>Total</b>	<b>7,641</b>	<b>6,185</b>	<b>7,850</b>	<b>3,848</b>

*(x) West African Spanish Mackerel*

G.D.R.	--	--	851	537
Ghana	4,412	1,983	2,982	2,771
<b>Total</b>	<b>4,412</b>	<b>1,983</b>	<b>3,833</b>	<b>3,308</b>

*Source:- FAO 1983 yearbook of fishery statistics, Vol. 56.*

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